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ABSTRACT

As part of the Competency Based Teacher Certification Project in Carroll County, Georgia, large samples of elementary and secondary school teachers and students were observed during a two-year period. Four low-inference observation measures were used to record teacher behaviors and student-teacher interactions: (1) Teacher Practices Observation Record (TPOR); (2) Spaulding Teacher Activity Rating Schedule (STARS); (3) Observation Schedule and Record (OSCAR); and (4) Florida Classroom Climate and Control System (FLACCS). Three major areas of student growth were also examined: cognitive gains on standardized achievement tests; affective growth on self concept tests; and student coping style, as recorded on the Coping Analysis Schedule for Educational Settings (CASES). Clusters of items from the observation instruments were aggregated as behavioral indications of teacher competency. Reliability data were computed, as well as the correlations between teaching competencies and measures of student growth. A cross-validation technique was also used to combine probabilities from the first and second years of data collection. Results indicated that the observation instruments were reliable indicators of teacher competency; that significant correlations were not consistent from year to year; and that many of the teacher competencies should be renamed. (GDC)

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THE RELATIONSHIPS BETWEEN LOW-INFERENCE MEASURES OF CLASSROOM BEHAVIOR AND PUPIL GROWTH: A CROSS-VALIDATION

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THE RELATIONSHIPS BETWEEN LOW-INFERENCE MEASURES OF CLASSROOM BEHAVIOR AND PUPIL GROWTH: A CROSS-VALIDATION

by

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The present paper is a discussion of the cross-validation using data collected over two years in Carroll County, Georgia, by the Competency Based Teacher Certification Project. In this project, these data were gathered on more than 1800 students in 59 classrooms (grades 1-12) during the 1974-75 school year, and on more than 1300 students in 41 classrooms (grades 1-12) during the 1975-76 school year. The rationale for and the design of this project were reported in an AERA paper (Lorentz, 1976) which includes a complete description of all the instruments used and a thorough discussion of the procedures.

Measures

Teacher behaviors and teacher-student interactions were recorded with four low-inference observation measures: STARS, OScAR, FLACCS, and TPOR. Three major areas of student growth were measured with a variety of instruments: Cognitive growth with standardized achievement tests, Affective growth with paper and pencil self-concept measures, and student Coping Style by direct observation using CASES. (Student growth measures are listed in Appendix 1.)

Data Reduction:

Data collected on teachers and students in 59 classrooms during 1974-75 (First Year) were reduced to classroom-level indices so that process-product relationships could be examined. In an AERA symposium presented at the New York meeting (1977), Medley discussed the reduction of the competency measures from observation data, Lorentz described the steps taken in the reduction of student data, and Soar discussed the various process-product relationships between competency measures and student growth for the First Year (1974-75) sample.

Using the analytical procedures developed for the First Year analyses, the data collected in the 41 classrooms during 1975-76 (Second Year) were also reduced to classroom-level indices.

These indices were computed on First and Second Year samples independently as follows: clusters of items from the observation instruments were aggregated (separately for each instrument as appropriate and together across instruments) as behavioral indicators of teacher competency, or "competency scores". These composite scores were produced as *a priori* measures of the

"competencies" set forth by Carroll County teachers in 1974. These competencies were derived from several lists of competency statements as well as local and state goals.

The reliability of these composite scores was estimated independently on the First and Second Year data using a procedure developed by Medley (1977). This coefficient of reliability estimates the correlation between a set of scores based on K items made by R recorders visiting the C classrooms and a similar set of scores based on K other items made by R other recorders visiting C classrooms at other times. The reliability coefficient then, is reduced by errors of measurement due to inconsistency of items, instability of teacher behavior, and recorder disagreement. For a score based on one instrument, the following formula was used to estimate the reliability:

$$r = \frac{a - b - c + d}{a}$$

Where
a = variance due to differences between classes
b = variance due to item inconsistency
c = variance due to instability of behavior
d = variance due to residual error

The variances are mean squares from an Analysis of Variance.

When the composite was scored on more than one instrument, the score was based on the mean across all recorders for one item and the reliability was estimated as follows:

$$r = \frac{a - c}{a}$$

Where
a = variance due to difference between classes
c = residual variance due to the interaction of classes and items (within instrument)

The separate reliability coefficients for each composite based on Year 1 and Year 2 data were pooled for the total sample of 100 classes using the formula

$$r_{avg} = \frac{r_1 df_1 + r_2 df_2}{df_1 + df_2}$$

These average reliability coefficients are presented for Teacher Behaviors in Table 1 and for Pupil Behaviors in Table 2. Where a

INSERT TABLES 1 AND 2 HERE

coefficient is not shown, the behavior was not scored on that instrument since the instrument was judged a priori to reflect that behavior.

Student outcome measures were reduced to adjusted end-of-year classroom means (i.e., regressed gains) for each subtest of each instrument. The initial (Fall) test and student social status were used as covariates to adjust the Spring scores. The resulting indices are measures of class growth which are independent of pretest and social status. In the First Year, 58 measures were applied to students; 46 were used in the Second Year. Of these, 41 were used both years and are thus comparable.

Correlations

The 104 measures of competency were correlated with the 41 measures of student outcome separately for the 59 First Year classrooms and for the 41 Second Year classrooms. The results of this procedure are summarized as follows:

Total number of competency-gain correlations (each year) 4264

Number of significant ($p<.05$) correlations:

Year 1	449 (10.5%)
Year 2	391 (9.2%)
Both years	58 (1.4%)

The relationships between these two sets of significant correlations is shown in Figure 1.

INSERT FIGURE 1 HERE

It was apparent that, while twice as many of the correlations were statistically significant each year than would occur by chance, there was little overlap from year to year.

Cross-validation

Gordon, Loveland, and Cureton (1952), however, suggest that in duplicate studies using small samples, "the null hypothesis may not be rejected with any great certainty on the basis of any one study". They suggest using the technique developed by Fisher for combining probabilities from several studies. This

involves converting the exact probability to a Chi-square with two degrees of freedom and then summing the values for each study. The result is then itself a Chi-square value which reveals the aggregate probability.

Consequently, the two independent probabilities were combined for each of the 4264 (104 x 41) comparable pairs of First and Second Year correlations, using the formula:

$$\chi^2 = -2(\log(P_{r_1}) + \log (P_{r_2}))$$

where P_{r_1} = Probability of correlation of 1st Year sample

P_{r_2} = Probability of correlation of 2nd Year sample

and df = 4.

If the signs of the two correlation coefficients differed, the probability of the larger correlation (i.e., the smaller P-value) was converted to 1-P prior to conversion to Chi-square.

When aggregate probabilities had been computed, it was found that 348, or approximately 8.2% , of the total correlations were significant ($p<.05$).

Table 3 presents the number of significant correlations between each of the 41 student growth measures and the competency

INSERT TABLE 3 HERE

measures for Year 1 and Year 2 samples and for the combined analysis. Tables 4 and 5 present the number of significant correlations

INSERT TABLES 4 AND 5 HERE

separately for each indicator and for each instrument on which the composite was scored. Finally, Tables 6 and 7 present the

INSERT TABLES 6 AND 7 HERE

number of significant negative correlations for each indicator/instrument for both Year 1 and Year 2.

Discussion

An examination of the reliability coefficients reveals that low-inference observation measures can be scored on an a priori basis as reliable indicators of teacher competency. However, the addition of scales from several instruments may result in a more reliable scale (e.g. 3a - Clear, Explicit Directions) or it may result in a scale with lower reliability than any of the scales scored on separate instruments (e.g. 4a - Demonstrates proper listening skills). In most cases, a scale scored on a single instrument may be the best measure of a competency.

The lack of consistency in the significant correlations from year to year is somewhat disappointing. However, the use of aggregate probabilities is useful in detecting persistent relationships.

Finally, the large number of negative correlations suggests that many of the teacher identified competencies should in fact be renamed.

Conclusion

These data provide strong evidence that direct observation in actual settings can be used to provide stable measures of effective teaching. It also suggests that independent studies should be assessed by techniques which take into account aggregate trends. The aggregation of probabilities from two (or more) independent samples of reliable data is a much more compelling indicator of stable relationship than is the result of a single study.

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TABLE 1

COEFFICIENTS OF RELIABILITY OF SCORES OF 100 TEACHERS ON

PROPOSED MEASURES OF 27 INDICATORS OF COMPETENCY BASED ON TEACHER BEHAVIORS

INDICATOR		INSTRUMENT					
		STARS	OScAR	FLACCS	TPOR	MULTIPLE INSTRUMENT Reliability	MULTIPLE INSTRUMENT Composition
2a	Goals/objectives appropriate to pupil needs				000		
2b	Materials appropriate				098		
2c	Multi-level materials				000		
2d	Pupils involved in planning/organizing		622				
3a	Clear, explicit directions	247	388		028	653	SOT
3b	Pauses for & responds to pupils' questions	368		459		441	SF
3c	Variety of methods	558		167		296	SF
4a	Demonstrates proper listening skills	212	134	539		000	SOF
4b	Respects individual's right to speak	570	417		049	560	SOT
4c	Uses non-verbal communication skills			333			
5a	Uses pupil feedback to modify own behavior	624					
5b	Flexibility in classroom management	687					
5c	Opportunity for pupil-initiated questions		147				
5d	Makes contact with pupil not on-task	792					
5e	Feedback on pupil behavior			361			
5f	Helps pupil correct cognitive misperceptions				067		
6a	Maintains self-control	572	410	532	000	843	SOFT
6b	Recognizes, treats individual pupil behavior			152			
6c	Seeks help from others			166			
8a	Opportunity for pupil to meet success daily		228				
8c	Personal one-to-one relationship w/ each pupil			351			
8d	Pupil voice in decision-making		459				
8e	Praise/rewards	245	487	465	007	746	SOFT
8f	Supportive classroom management			112			
9a	Accepts, uses pupils' ideas		237		000	506	OT
9b	Listens to pupil and gives feedback		092				
9c	Opportunity for one-to-one counseling; no brush-offs	418		139	000	569	SFT

TABLE 2

COEFFICIENTS OF RELIABILITY OF SCORES OF 100 TEACHERS ON

PROPOSED MEASURES OF 21 INDICATORS OF COMPETENCY BASED ON PUPIL BEHAVIORS

INDICATOR		INSTRUMENT					
		CASES	OScAR	FLACCS	TPOR	MULTIPLE INSTRUMENT Reliability	MULTIPLE INSTRUMENT Composition
1b	Reduced deviant behavior			592	279	826	FT
1c	Better physical, mental health			557			
2a	Enjoys class, happy, relaxed			063			
2b/c	On task, actively involved	189		602	097	790	CFT
2d	Absence of withdrawn behavior	000		370			CF
3a	Less confusion, time-wasting	089					
3c	Self-directed	263		355		536	CF
4b	Able to speak freely	298	294			512	CO
4c	Able to follow directions	000		335		100	CF
4d	Discriminates acceptable/inacceptable behavior			544			
5b	Free to interrupt	185	487	518		540	COF
5c	Movement toward tasks			530			
6a	Absence of manipulative behavior	314					
7a	Attending behavior	096					
7c	Actively involved	190	199		097	694	COT
8b	Moving toward self-direction				000		
8e	Group involvement/acceptance	353		312		000	CF
8f	Responsible for own success/failure				000		
8g	Enthusiasm			590			
9a	Expresses opinions different from others		363		000	362	CT
9b	High interest	214		761		102	CF

TABLE 3

NUMBER OF SIGNIFICANT CORRELATIONS BETWEEN
STUDENT GROWTH MEASURES AND COMPETENCIES

STUDENT GROWTH MEASURES	NUMBER OF SIGNIFICANT CORRELATIONS Year 1	Year 2	Combined
Student Coping Style			
Coping Analysis Schedule for Educational Settings			
Teacher Directed Setting			
Style 1A - Agressive, Manipulative	40	15	28
1B - Inappropriately Self-directed	25	27	30
1C - Passive, Withdrawn	9	17	13
1D - Peer Dependent	7	19	9
1E - Compliant	15	5	9
1F - Social, Productive	16	4	7
1G - Inner-directed, Task-oriented	4	5	1
1H - Other-directed, Task-oriented	1	22	11
Overall - Composite of A-H	21	16	18
Program Directed Setting			
Style 3A - Agressive, Manipulative	7	3	3
3B - Inappropriately Self-directed	4	8	0
3C - Passive, Withdrawn	4	7	8
3D - Peer Dependent	6	21	8
3E - Compliant	4	4	3
3F - Social, Productive	20	18	16
3G - Inner-directed, Task-oriented	9	8	2
3H - Other-directed, Task-oriented	18	24	19
Overall - Composite of A-H	22	26	30

TABLE 3 (continued)

STUDENT GROWTH MEASURES	NUMBER OF SIGNIFICANT CORRELATIONS Year 1	Year 2	Combined
Student Achievement Measures			
Iowa Tests of Basic Skills			
V - Vocabulary	12	3	2
R - Reading Comprehension	9	1	2
L_1- Language 1 (Spelling)	13	7	7
L_2- Language 2 (Capitalization)	4	11	0
L_3- Language 3 (Punctuation)	17	9	9
L_4- Language 4 (Usage)	12	9	10
L_T- Total Language	14	7	9
M_1- Math 1 (Concepts)	6	5	5
M_2- Math 2 (Problem Solving)	4	5	2
M_T- Total Math	6	6	5
Tests of Academic Progress			
R - Reading	3	2	1
Student Affect Measures			
I Feel Me Feel			
Academic	6	5	3
Self	2	2	2
Frustration	8	7	11
Femininity	2	1	0
Fun	13	3	6
Independence	5	8	2
How I See Myself			
Teacher-School (Academic)	30	2	5
Physical Appearance	0	10	7
Interpersonal Adequacy	23	26	24
Autonomy	17	4	10
Academic Adequacy	7	7	11
Junior Index of Motivation	4	2	0

TABLE 4

NUMBER OF SIGNIFICANT CORRELATIONS BETWEEN
MEASURES OF COMPETENCY AND STUDENT GROWTH MEASURES

(Teacher)

INDICATOR	INSTRUMENT														
	STARS			OSCAR			FLACCS			TPOR			MULTI-INSTRUMENT		
	Year 1	Year 2	Comb	Year 1	Year 2	Comb	Year 1	Year 2	Comb	Year 1	Year 2	Comb	Year 1	Year 2	Comb
2A										4	3	2			
2B										2	7	2			
2C										3	3	2			
2D				7	4	10									
3A	4	6	2	1	2	2				0	1	0	3	3	2
3B	2	4	4				2	0	0				1	1	2
3C	2	9	4				0	7	0				1	4	1
4A	5	3	6	3	3	2	3	6	2				8	4	3
4B	2	2	2	0	2	0				5	3	1	0	3	2
4C							3	6	4						
5A	8	5	8												
5B	2	2	0												
5C				3	1	0									
5D	12	3	7												
5E							4	4	2						
5F										2	1	1			
6A	0	5	2	8	1	3	13	0	5	0	1	0	12	1	4
6B							3	1	1						
8A				2	1	0									
8C							4	5	0						
8D				1	5	3							1	5	3
8E	1	4	1	2	0	0	4	4	4	5	2	1	3	4	2
8F							2	8	2						
9A				4	1	1				2	5	3	4	2	2
9B				1	3	2									
9C	1	1	1				7	2	4	0	3	0	3	1	3

TABLE 5

NUMBER OF SIGNIFICANT CORRELATIONS BETWEEN
MEASURES OF COMPETENCY AND STUDENT GROWTH MEASURES

(Pupil)

INDICATOR	INSTRUMENT														
	CASES			OSCAR			FLACCS			TPOR			MULTI-INSTRUMENT		
	Year 1	Year 2	Comb	Year 1	Year 2	Comb	Year 1	Year 2	Comb	Year 1	Year 2	Comb	Year 1	Year 2	Comb
1B							13	5	5	6	0	1	12	4	6
1C							5	5	9						
2A				1	4	2	7	1	6				1	5	1
2B/C	8	12	10				11	3	9	4	7	7	16	6	14
2D	3	4	3	1	4	2	2	3	3				1	6	3
3A	7	6	9												
3C	2	9	10				10	2	2				11	5	9
4B	5	8	6	6	2	4							6	0	3
4C	1	4	1				12	5	4				5	4	4
4D							11	5	7						
5B	5	7	4	4	5	5	1	4	0				4	6	4
5C							3	6	3						
6A	8	2	5												
7A	3	7	2												
7C	8	12	10	1	4	2				4	7	7	4	3	4
8B										0	1	0			
8E	2	2	2				4	1	1				5	6	4
8G				1	4	2	12	2	5				4	6	3
9A				3	0	0				8	2	3	3	0	1
9B	7	7	8				0	4	1				13	7	12

TABLE 6

NUMBER OF SIGNIFICANT NEGATIVE CORRELATIONS

(Teacher)

INDICATOR	INSTRUMENT									
	STARS		OScAR		FLACCS		TPOR		MULTI - INSTRUMENT	
	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
2A							2	2		
2B							0	4		
2C							0	1		
2D			1	2						
3A	2	2	1	0			0	1	2	1
3B	0	2			1	0			0	1
3C	1	5			0	6			1	2
4A	1	1	3	2	2	2			4	1
4B	1	0	0	0			2	1	0	0
4C					1	5				
5A	3	2								
5B	1	0								
5C			1	0						
5D	10	1								
5E					2	0				
5F							1	0		
6A	0	4	2	1	2	0	0	0	2	0
6B					1	0				
8A			0	0						
8C					1	3				
8D			0	4					0	4
8E	0	1	2	0	2	1	2	2	3	1
8F					2	6				
9A			2	1			1	2	2	2
9B			0	2						
9C	1	0			0	1	0	2	2	1

TABLE 7

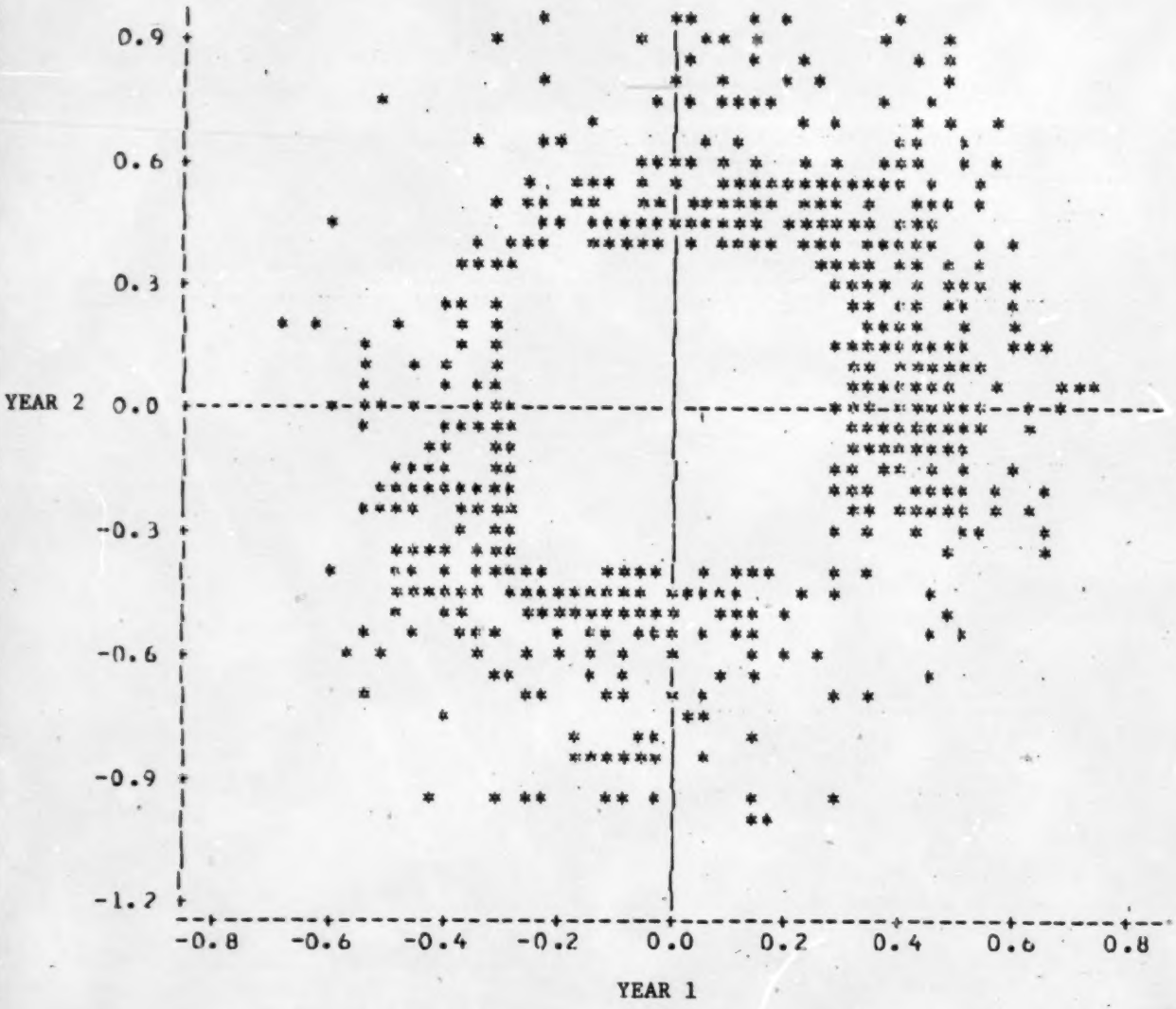
NUMBER OF SIGNIFICANT NEGATIVE CORRELATIONS

(Pupil)

INDICATOR	INSTRUMENT									
	CASES		OScAR		FLACCS		TPOR		MULTI - INSTRUMENT	
	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
1B					2	3	1	0	2	3
1C					1	2				
2A			0	2	2	1			0	2
2B/C	5	5			2	2	1	2	3	3
2D	2	2	0	2	0	1			1	3
3A	2	2								
3C	2	4			1	1			1	2
4B	1	3	3	2					3	0
4C	0	2			1	2			1	2
4D					1	3				
5B	2	2	0	1	1	3			2	1
5C					0	3				
6A	4	1								
7A	2	2								
7C	5	5	0	2			1	2	1	2
8B							0	0		
8E	0	1			2	1			1	2
8G			0	2	6	2			2	3
9A			2	0			2	1	2	1
9B	2	3			0	3			3	3

FIGURE 1

PLOT OF SIGNIFICANT CORRELATIONS



APPENDIX 1

STUDENT GROWTH MEASURES

CBTC PROJECT

Grade	Code	Description	Reference
Student Achievement Measures			
1	IST	Scott Foresman Initial Survey Test, Form A (pretest)	Monroe, Manning, Wepman, and Gibb, 1972
	IST R	Reading Subtest	
	IST M	Math Subtest	
	CTBS	Comprehensive Test of Basic Skills, Level B, Form S (posttest)	CTB/McGraw-Hill, 1974
	CTBS R	Reading	
	CTBS M	Math	
2	ITBS-P	Iowa Tests of Basic Skills, Level 7, Form 6	Hieronymus, Lindquist, and others, 1972
	Voc.	Vocabulary	
	W. Anal.	Word Analysis	
	Read	Reading Comprehension	
	L-1	Language 1 (Spelling)	
	M-1	Math 1 (Concepts)	
	M-2	Math 2 (Problems)	
3 - 8	ITBS	Iowa Tests of Basic Skills, Form 5 and 6	Hieronymus and Lindquist, 1971
	V	Vocabulary	
	R	Reading Comprehension	
	L_1	Language 1 (Spelling)	
	L_2	Language 2 (Capitalization)	
	L_3	Language 3 (Punctuation)	
	L_4	Language 4 (Usage)	
	L_T	Total Language	
	W_1	Work-Study Skills 1 (Map Reading)	
	W_2	Work-Study Skills 2 (Reading Graphs & Tables)	
	W_3	Work-Study Skills 3 (Knowledge & Use Reference Materials)	
	W_T	Total Work-Study Skills	
	M_1	Math 1 (Concepts)	
	M_2	Math 2 (Problem Solving)	
	M_T	Total Math	
High School	TAP	Tests of Academic Progress, Form S	Hieronymus and Lindquist, 1971
	S	Science	
	R	Reading	

APPENDIX 1 (continued)

Grade	Code	Description	Reference
Student Coping Style Measure			
1-12	CASES	Coping Analysis Schedule for Educational Settings	Spaulding, 1974
	TD	Teacher Directed Setting	
	PD	Program Directed Setting	
	Style A	Aggressive, Manipulative	
	B	Inappropriately Self-directed	
	C	Passive, Withdrawn	
	D	Peer Dependent	
	E	Compliant	
	F	Social, Productive	
	G	Inner-directed, Task-oriented	
	H	Other-directed, Task-oriented	
	Overall	Composite of A - H	
Student Affect Measures			
1 - 3	IFMF	I Feel Me Feel	Yeatts and Bentley, 1970
	Aca.	Academic	
	Self	Self	
	Frus.	Frustration	
	Fem.	Femininity	
	Fun	Fun	
	Ind.	Independence	
4 - 12	HISM	How I See Myself	Gordon, 1968
	T,S	Teacher-School (Academic)	
	P.A.	Physical Appearance	
	Int.	Interpersonal Adequacy	
	Auto	Autonomy	
	Aca.	Academic Adequacy	
8 - 12	JIM	Junior Index of Motivation	Frymier, 1970
Other Measures			
1 - 12	SES	Socioeconomic Status Based on Father's Occupation	Warner, Meeker, and Eells, 1960.